DEPARTMENT OF AGRICULTURE, CEYLON.

BULLETIN No. 63.

BEE-KEEPING FOR BEGINNERS.

BY

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DEPARTMENT OF AGRICULTURE, CEYLON.

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BEE-KEEPING FOR BEGINNERS.

Introduction.

THE object of this publication is four-fold, viz., (1) to serve as a manual of instruction to beginners in bee-keeping; (2) to present, in collected form, information gathered from various sources, and from personal experience about the local honey bees; (3) to take stock of the present position of bee-keeping in Ceylon; and (4) to give an opportunity for discussion on a subject that has hitherto received little attention, and about which there are very few records.

Bee-keeping has recently been introduced into our rural schools, and while it is being enthusiastically taken up by many teachers and their pupils, it is also becoming popular among all classes.

Some years ago Mr. A. P. Goonetilleke, who has devoted much study to the subject, published a work in Sinhalese, copies of which he has distributed free. This book has been the means of inducing many of his countrymen to keep hives. My thanks are due to him for assistance in the compilation of these notes.

Classification of Bees.

The honey bee belongs to the class *Insecta*, and to the sub-class *Hymenoptera*. The parts of its body are jointed, and consist of head, thorax, and abdomen; it has no internal skeleton; it breathes through a series of tubes branching all over its body, which are fringed with hairs to exclude dust, &c.; the wings are membranous. The family to which the bee belongs is called *Apidæ*, the members of which feed their young on pollen or pollen and honey; and possess receptacles (pollen baskets) formed by the widening of the first joint (tarsus) of the two hind legs, and the hollowing out of the tibia or shin bone. The genus of the honey bee is known as

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Apis. The bees of Europe belong to the species *mellifica*, of which there are many varieties, such as the German or black bee, the Italian, Carniolan, &c.; and from these some useful hybrids have been produced. The bees of the East belong to entirely different species.

The Bee Colony.

The bee colony is made up of three different kinds of bees, viz., the queen, the drone, and the worker.

The *queen*, or mother bee, is the only perfectly developed female in the hive. She can be distinguished by her greater length and comparatively shorter wings.

The queen meets the drone but once, when fertilization takes place in the air; and this suffices for the production of worker eggs practically through the lifetime of the queen, who will lay up to a thousand or more eggs in a day, according to the season. If a queen should not meet the drone, she can still lay eggs, but these, on hatching, produce only drones. This strange phenomenon is known as parthenogenesis.

The success of the colony rests entirely with the queen, who must, therefore, be young and vigorous and prolific, if the colony is to be kept strong and active.

When the queen's powers of reproduction begin to wane, the bees themselves generally replace her with a fresh queen; but if this is not done by them, the bee-keeper should do it.

The queen possesses a sting, but has been rarely known to use it.

The *drone*, which is the male bee, is larger than the worker bee, and darker in colour; its eyes, too, are larger, closer together, and more prominent. It is stingless, and carries no "pollen baskets." The duty of the drone is to fertilize the queen, but why drones should be produced in such large numbers it is difficult to explain. The theory that they are required to raise the temperature of the hive and help in the evaporation of the honey is not now held. When their presence is not desired, especially after the fertilization of the queen, the drones are slaughtered in large numbers by the workers.

The *worker bee*, which is lighter in colour than the drone, is an undeveloped female, and is a familiar object, as it flits about from flower to flower gathering nectar and pollen. It is the smallest bee in the hive, but the most active, and is furnished with a sting which it is always ready to use when annoyed. The worker carries "pollen baskets," *i.e.*, receptacles for holding pollen, one on each leg, and is furnished with a long tongue adapted for gathering nectar. Under the

reticulations of the abdomen are wax pockets, in which wax is secreted for comb-building. In the front part of the abdomen is a receptacle called a honey sac, in which nectar is collected. Under exceptional circumstances, workers have been known to lay eggs, but these only produce drones.

All the duties of the hive are performed by the worker bee. It feeds the queen and larvæ, constructs comb, gathers honey, water, pollen, and propolis. (This last is of a gummy resinous character, and is used for stopping crevices or fixing loose parts in the hive.)

The worker also attends to the ventilation of the hive by fanning out the hot, vitiated air, and fanning in cool, fresh air; sees to its sanitation by cleaning out all waste and useless matter, even to the removal of dead bodies; lastly, the worker is the policeman and soldier, always on guard, and ready to fight when necessary.

Ceylon Honey Bees.

The honey bees of Ceylon are :—

(1) *Apis indica* (*Memessa* S.), the common honey bee of the East, the only species of Apis that has been domesticated. Like the bee of the West, it naturally builds a series of parallel combs in cavities and recesses, and is therefore amenable to the conditions of the modern frame. It is smaller than *A. mellifica*, which builds combs $\frac{7}{8}$ inch thick, in which the worker cells show 29 to the square inch. *A. indica* worker combs are only $\frac{5}{8}$ inch thick, and 36 cells go to the square inch.

(2) *Apis dorsata* (*Bambara* S), the giant bee of the East, sometimes called the rock bee, and often confused with the wasp, is larger and less tractable than the last mentioned, and builds enormous single combs (5 to 6 feet long and 3 to 4 feet wide) in the open, on the branches of trees, below bridges, or under the ledges of rocks. About 15 worker cells go to the square inch. The honey is dark in colour and strong in flavour. Being extremely vicious, a swarm cannot be disturbed with impunity. Owing to its character as a hardy bee, an assiduous worker, and a prolific source of honey and wax, many persistent attempts have been made, both by local bee-keepers and experts from Europe and America, to domesticate it, but so far without success. At the present time a scientific worker in England is endeavouring to cross it with the Western bee. Mr. Goonetilleke states that a single comb of the rock bee has been known to yield as much as 12 gallons of honey.

(3) *Apis florea* (*Danduwelmessa* S.) is a smaller bee than *A. indica*, and also of a milder disposition. Like the giant bee, it is an open air worker, building single combs on the branches of trees, but not, as the giant bee does, in lofty situations. The combs are small in size (about 9 by 5 inches), with nearly 100 cells to the square inch. The honey is of the finest description. All efforts to induce this bee to build in a frame hive have proved fruitless.

A fourth honey gatherer commonly met with is the dammar bee, *Melipona iridipennis* (*Kaneya* S.). It is smaller and milder than the last mentioned, and stores its honey not in cells, but in sacs agglutinated together by means of a resinous medium. This bee is by nature very domestic. It builds in any convenient cavity in dwelling-houses, and readily enters and establishes itself in an empty hive, but neglecting the frames builds irregular structures. The honey is of good quality, but difficult to extract. The dammar bee is scarcely worth the keeping, and is often a source of trouble to the common honey bee, whose hives it invades.

Life History of Apis indica.

Mr. Goonetilleke has contributed the following note based on his personal experience :—

An egg laid in a worker cell hatches out about the third day, till which time it can be seen standing on end at the bottom of the cell to which it is attached, "like an ivory comma" as one writer describes it.

After incubation, a maggot-like larva may be seen immersed in the liquid nutriment provided for it within the cell. About the second day this larva will be found to have curled itself round, and about the third day will be seen as an annular body. In this condition it will remain for a while, only increasing in size. About the ninth day the larva will stretch itself with its head towards the mouth of the cell; and about the twelfth it will undergo a change into the pupal form, and pass an interval in this chrysalis or resting stage, during which the different parts of the body are developed; finally emerging as a worker bee about the twenty-first day. On the ninth or tenth day—during this metamorphosis—the cell will have been capped with wax to the level of the comb; this capping being eventually gnawed through by the young worker or the attendant adult bees.

The drone passes through a similar series of changes, but it takes about twenty-four days to emerge as the perfect insect. The drone cells when sealed over for the resting stage have a capping that stands out well above the level of the comb, each cap presenting a conical head.

The queen, too, goes through this metamorphosis, but takes only fifteen or sixteen days to develop fully. The queen cell is generally capped on the sixth or seventh day, and the insect

remains in the pupal stage for six or seven days. The larva of the queen is fed on a special mixture, of a highly nutritive character, known as "royal jelly."

The Comb.

The comb is made up of hexagonal cells. These cells are not quite horizontal, but have an upward tilt. In the case of worker brood comb 6 cells go to the linear inch. Worker combs differ from either honey or drone comb in having the cappings a shade lighter than the surrounding comb, a level or slight convex surface, and a dull colour. Worker combs are always packed with brood in the middle of the hive, so forming what is known as the brood nest, which is spherical in outline. When honey is stored in worker cells, the cappings are irregularly concave, and have a shining appearance owing to their being formed of wax only, and not as in the case of worker brood cells of pollen and wax. Drone comb is similar in shape to worker comb, but the cells are larger, about five to the linear inch. When these cells are used for brood they are capped as in the case of worker cells, but the cappings are dome-shaped, and stand out in relief to allow more room for the larger inmates. The use of comb foundation tends to reduce the number of drone cells formed.

Both worker and drone comb is used by bees for storing honey. The worker cells surrounding the brood nest, on top and sides, are used for honey, rarely those below, where drone cells are usually found. Pollen is often stored with honey, but only in worker cells. When honey is plentiful, it is stored in comb made of cells of drone size, and such comb may be thickened out to 1 or 1½ inches. *A. indica* seldom or never builds separate worker and drone comb.

Queen cells are only found at certain seasons. They are composed of mixed wax and pollen, and are different in shape from any other. The bees usually select the edge of a comb (sometimes a hole in the comb) for building them. After an egg is hatched in a worker cell, the bees enlarge the walls, and build a hollow cylindrical structure. In the course of feeding the larva, the cell is gradually elongated downwards, and when complete is capped, when it somewhat resembles the pod of a ground-nut in shape.

The average thickness of *A. indica* comb, as already stated, is about $\frac{5}{8}$ inch, and the space between one comb and another, in order that the bees may work conveniently, should not be less than $\frac{9}{8}$ inch. With the bars of the frames $\frac{7}{8}$ inch wide, and retaining a space of $\frac{1}{4}$ inch between the frames, the distance between the centres of continuous frames will be $1\frac{1}{8}$ inch.

Old and Crude Methods.

The people of Ceylon have been known to keep bees from time immemorial, after their own fashion. In the remotest parts of the Island honey is gathered by bee hunters, who rout the bees from their natural homes, generally with the aid of a torch, destroying much bee life in the process of robbing the hives.

According to the old method of domestication, bees are attracted to a clay pot, previously fumigated by resin smoke and smeared with honey, with its mouth set against a tree, and an aperture provided on the convex side to serve as an entrance. This preparation is made about the swarming period, and, when the honey season comes round, the bees are driven away, either by smoke, frequently raised by burning chillies, or by the operator blowing on to them through a hollow tube after chewing peppercorns. If the original pot has to be broken in the removal of the honey, another is set up in the same place, and generally attracts the bees again.

The result of such a system of bee-keeping is, as might be expected, to perpetuate the honey bee as a wild creature that looks upon man as its natural enemy. But what is most to be deplored is the enormous destruction of bee life. The object of modern methods of bee-keeping is to induce docility in the bee, by giving it every convenience and comfort, and treating it as humanely as possible.

Previous Efforts at Improvement.

Within the past fifty years various attempts have been made, by persons interested in bee-keeping, to improve upon the crude methods just described.

Among the older generation of bee-keepers who adopted improvements were the late Messrs. C. Jayatilleke, W. H. Wright, and Joseph Holloway; while Mr. Charles Andree, who has designed a hive of his own, is still a worker in the field of apiculture. In more recent times Messrs. Mathew Shanks, Herbert Campbell, A. P. Goonetilleke, H. G. Stevens, Rolf Smerdon, S. W. Illangakoon, J. P. Obeyesekere, and Claude Crozier have given special study to the habits of the Ceylon honey bee, with a view to its domestication under the most favourable conditions, with advantage to the bee as well as the bee-keeper. Ultimately an association was formed a few years ago, with the object of popularizing bee-keeping as a cottage industry; and this society took up the question of a suitable hive, not so much as an ultimate standard, but as a working basis, with the idea of effecting further improvements as the

result of further observation, study, and experience. This type of hive is now being extensively employed throughout the country, both in schools and among private individuals.

Another step forward was the introduction of comb foundation suitable for Ceylon bees. This is now prepared locally by means of a special machine constructed in America for the purpose.

The Association also arranged (through the good offices of Mr. Claude Crozier) for the supply of hives, queen excluders, entrance guards, bee escapes, &c., for, owing to the difference in size between the Western and Eastern bee, the appliances used in Europe and America are not suitable for local use.

The latest point gained in the encouragement of bee-keeping in Ceylon is the appointment by Government, on the recommendation of the Director of Agriculture, of an instructor in bee-keeping, whose chief work lies among the rural schools, but whose services are available to the public also.

With the large and increasing number of schools at which hives are kept, it will become necessary before long to appoint additional instructors, and it is also likely that in the near future the work initiated by the Ceylon Bee-keepers' Association will be taken over and developed by the Department of Agriculture.

The Hive and Super.

The modern hive consists of a wooden box, into which are fitted a number of frames so suspended as to be parallel to one another. It is furnished with a movable cover or lid and a bottom board to serve as the floor of the hive. This floor board is extended in front to serve as an alighting ground for the bees, from which they can pass freely in and out of the hive through an opening called the entrance. When this hive is fully occupied, and more room is needed for the storage of surplus honey, a super-structure, called a "super" for short, is provided, consisting of another box similar to the first, but, as a rule, shallower, and fitting exactly over it. The lower box, or hive proper, is generally spoken of as the brood box, because it is occupied by the queen bee and the brood she is continually raising in it. In the super the combs should contain only honey. Honeycombs could thus be removed without seriously disturbing the breeding and feeding arrangements in the hive. The frames in the super should be spaced wider apart, as the combs for honey storing are more than ordinarily thick.

The most important points in a hive are the dimensions of the frames, and their "spacing" or the intervals between them (which must be neither too great or too small) to allow the bees to work with convenience, and to build their combs regularly. As already stated, English hives are not suitable for our bees. Professor Benton, the well-known authority on bees, while on a visit to Ceylon many years ago, suggested a frame 8 inches deep by 13 inches long (outside measurements), the bar of the frame to be $\frac{7}{8}$ inch, and the space between end of frame and side of hive $\frac{1}{4}$ inch, thus making the hive from front to rear, $13\frac{1}{2}$ inches; the width of the hive, to accommodate eight frames, to be $9\frac{1}{4}$ inches (inside measurement), allowing $1\frac{1}{8}$ inch to each frame ($\frac{1}{8}$ inch space on either side of it) and $\frac{1}{4}$ inch for the two end spaces.

The recommendations of the Committee appointed by the Ceylon Bee-keepers' Association to consider the question of a suitable hive for *A. indica* were somewhat different. They favoured a frame 5 inches by 11 inches. The following were the considerations which weighed with the Committee:—

Normally bees prefer to build combs about 6 inches deep, the lower 4–5 inches being used for brood. The nest is generally oval in shape, 4–5 inches deep and 8–10 inches long, with honey stores around it. Small frames (say, 3–4 inches deep) would tend to limit the laying capacity of the queen, and necessitate the use of the first super as a brood box, so that no clean honey will be available till the second super is reached. The use of two brood boxes would entail a loss of honey, since each chamber will need to be supplied with honey for the young bees, while there will be undue delay in honey being stored in the second super.

Deep frames (say, 8 inches) would tend to delay the bees rising into a super, since they will have ample room for all their requirements in the brood box; and such honey as may be available will be contaminated, and there will be considerable inconvenience and trouble in removing it.

Sufficient depth is only needed for the brood, with enough room around for storing honey and pollen for feeding it; and, by not providing too much room below, the bees will be forced up to the super to store pure honey there.

In the case of large hives which are not fully occupied, there is trouble to be apprehended from wax moth, as well as from the circumstance that an even temperature would not be possible in the hive.

With frames of the size recommended (11 inches by 5 inches) it was urged that the necessary space for the nest and for bee food will be provided, and the super will be utilized for storing

surplus honey without interference with the brood chamber, the honey being also available more quickly and in pure form.

It was pointed out that a hive containing ten frames, each 11 inches by 5 inches will provide about 40,000 cells. Calculating 36 cells to the square inch, and 55 square inches per frame, there will thus be 1,980 cells on each surface, or 3,960 on the two surfaces of each frame.

A stock of *Apis indica* bees is estimated to consist of from 28 to 30,000 bees, so that a balance of about 10,000 will be available for food storage, which was considered ample.

Originally, the hive was provided with double walls and a roof-shaped lid ; but a single-walled hive, with a flat board cover as lid, is considered suitable for tropical conditions (provided the hive is kept protected from sun and rain), being less expensive to construct and more convenient to manipulate. With the flat cover there is less chance of bees being crushed when the hive is examined, while it will do away with the quilt, and also prevent bees clustering in the space formed by the angle of the roof cover. If a hive with a flat lid has to be placed in the open, it can always be protected by means of a light portable roof when necessary.

It is probable that further alterations for improving the type of hive now in use (particularly in the matter of better ventilation) will be found necessary as more experience is acquired.

The elimination of the wide divergence in the structure of hives that existed in the past is a distinct point gained, and it is likely that in course of time an ultimate standard will be reached ; with the present general tendency for large hives it is probable that the size of frames will be increased.

An Indian authority advocates the British standard hive, with frames 14 inches by 8½ inches with but slight modification, and the arrangement of the frames parallel to the entrance. With reference to this arrangement of frames, Mr. A. P. Goonetilleke states that it may be suitable for cool climates, but not for tropical conditions. All modern hives have the frames arranged at right angles to the entrance. It has been stated that in nature *A. indica* bees build their combs invariably at right angles to the entrance, but this is not the case.

The Danzenbaker type of frame, which is reversible, is preferred by some bee-keepers.

Hives for educational purposes are provided with movable shutters on the sides, with glass panes beneath. These are known as " observation hives."

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Products of the Hive.

Honey.—Nectar, which is honey in crude form, is gathered from honey-producing flowers; and in the process of gathering it, the bees assist in fertilizing the flowers. This nectar is generally of a watery consistency, but the excess of moisture is evaporated in the honey sac of the bee, where it also undergoes certain chemical changes. In the cells the honey undergoes further evaporation before it is sealed over with wax, when it is considered to be "ripe." Honey is fed to larvæ as raw honey or mixed with pollen as "bee bread." Six to eight pounds of honey per colony may be taken as a fair average yield for *A. indica*, but much larger yields have been taken.

Wax.—This is the material of which comb is constructed, and is secreted by the worker bees. The wax pockets are four in number, two on each side of the abdomen. Wax is a solid fat-like substance, and is produced in the form of scales, which are conveyed to the mouth, there to be moulded into strips or ribbons, and adjusted to any required portion of the comb.

Pollen.—This is the nitrogenous portion of the bee's food. On arriving at the hive with its load of pollen the worker bee scrapes away the lumps of pollen out of the "baskets" and leaves them at the entrance of the cells, to be packed in by the other bees. The cells are, as a rule, partially filled with pollen, and the honey placed over helps to preserve it.

Propolis.—This is collected by the worker chiefly from the buds of flowers of resin-yielding trees and shrubs, and is carried in the pollen baskets. In the hive it is removed by the other bees and drawn out into thin lines which are used for sealing purposes. Parts of the hive are often so firmly glued down by means of propolis that they need prizing with a hive-tool.

Accessories.

Excluder.—This is sheet zinc perforated with oblong holes of a size that workers can pass through, but not the queen. The object of placing an excluder sheet between the hive and super is that the queen may not travel upwards into the super and lay her eggs there, and so contaminate the honey.

Entrance Guard.—This is really a queen excluder adapted for use at the entrance of the hive to prevent the queen leaving it. It is employed in newly colonized hives when there is a risk of the queen being lost.

Queen Cage.—This is a trap for caging the queen, when she is captured from a swarm. It is also used when introducing a new queen into a colony.

Bee Escape.—This is a contrivance which permits bees to pass out, but not in. It is useful in taking supplies of honey

from the super with the aid of a "super clearer," which consists of a board, into the middle of which the bee escape is inserted, and placed between super and hive. The "super clearer" is so left for from 6 to 12 hours, at the end of which time the super ought to be quite clear of bees, so that the honey can be easily removed. The bee escape could also be used for clearing a swarm of bees out of a cavity and so getting at the queen. The value of the contrivance depends on two converging pieces of thin steel, which yield to the pressure of bees passing out, but offer resistence to bees attempting to pass in.

Gloves.—These are employed for protecting the hands against bee stings. Double woollen gloves (wetted before use) with gauntlets on the outer pair do very well. But gloves hamper the manipulator considerably. If not worn, the precaution should be taken to fasten down the wrists of the coat with an india rubber band.

Apifuge.—Any substance smeared over the hands which to some extent prevents bees from stinging them. Citronella oil may be used in this way with some effect.

Subjugators.—These are agents employed with the object of making bees more tractable. The most common is smoke; others are carbolic acid, chloroform, and creosote. When smoke is blown into a hive, the bees are thrown into a state of trepidation, and fill their honey sacs with honey from the open cells, with the result that they become surfeited and demoralized; in this condition they are comparatively harmless. In smoking bees a bellows arrangement called a smoker is employed. The great point in using a smoker is not to let the burning paper or other material go out in the process of manipulation. A few good heavy puffs at a time, skilfully directed across the top of the hive, should have the desired effect. Continuous ineffective puffing only irritates the bees.

Carbolic acid, creosote, &c., are used either in the form of vapour puffed through a bellows arrangement containing cotton soaked with the chemical; or sprinkled on a cloth to be spread over the tops of the frames for a while before manipulating.

The Veil.—This is employed for the protection of the face. Sudden movement caused by bees crawling over the operator's face is enough to irritate them. The best veil is that furnished with a wire gauze front. This prevents it from being blown against the face. In the case of an ordinary veil, black net is to be preferred, and loose ends should be tucked inside the collar of the coat. A wide-brimmed hat is essential.

The Quilt.—This is useful, not as in the West for preserving the warmth of the hive, but for preventing new swarms ascending up to, and clustering in, the roof. Quilts may be made of any material, but the great idea should be to prevent the bees from fixing them down by using a suitable material for the under surface. American enamel cloth quilts are specially recommended. With a flat lid, however, the use of the quilt can be dispensed with.

Dummy Board.—This is a solid piece of wood of the dimensions of a frame, and intended to take its place when necessary. In the case of a new swarm it will be found advisable to reduce the capacity of the hive to suit the size of the swarm, and to extend it as the colony increases. This reduction of accommodation is effected by the employment of dummy boards.

Comb foundation, or "foundation" for short, consists of a sheet of wax impressed by means of a machine with the shape of the base of the cells. It was invented in 1857, and is one of the most valuable aids to bee-keeping. The wax used must be absolutely pure. Pure wax is extremely difficult to procure locally, as it is a common practice to adulterate wax with gum, resin, &c. Foundation used in the body box is best wired to strengthen the combs carrying a large number of bees. The value of providing foundation will be realized from the fact that bees consume 10 or 12 lb. of honey in secreting 1 lb. of wax. Wood and aluminium base foundation is now being used in England and America.

Sections.—These are small, light frames used for fitting into the ordinary frames in the super. The best are made of one piece having a V cut where the fold is to take place, the two ends being square-dovetailed. The difficulty is to procure wood suitable for making sections. Even in the British Isles the best wood is not available, and sections are imported from Canada and the United States. Mr. Goonetilleke has induced *A. indica* to draw out and store honey in English foundation fitted into imported sections.

Hive Tool.—Bee-keepers should always carry with them a suitable tool for scraping frames and prizing them loose, as well as for separating supers glued down by the bees. It should also serve as a nail puller. Such an implement can easily be made by a blacksmith.

Bee Brush.—This should be a very soft brush which gives an easy, gentle sweep. One or two sweeps will free the combs of bees.

Swarm Catcher.—This consists of a wire-cloth basket, with a lid to close it, attached to a 12 feet pole, with two rods at the upper end to which the basket is fixed. For use the

basket is opened and placed round the swarm, which is shaken into the basket. Then the lid is closed by pushing it against a branch.

Uncapping Knife.—This is first heated by dipping in boiling water and then passed over the surface of the honey comb to uncap the cells before extracting the honey.

Honey Extractor.—Honey is extracted in many ways : by the heat of the sun, or by various contrivances for squeezing it out of the combs. In the patent honey extractor the uncapped combs are placed in "cages," and the honey drawn out of the cells by rapid centrifugal motion, the combs being left practically intact.

Foundation Machine.—This is a contrivance resembling a rubber roller, bearing impressions of hexagonal cells, which are imparted to thin sheets of wax passed between the rollers. The working of this machine requires considerable skill, both in the preparation of the wax sheets and in their rolling. A machine for preparing foundation for *A. indica* bees was made for the Ceylon Agricultural Society by the well-known American firm of "A. I. Root. Co.," and is now in the possession of the Ceylon Bee-keepers' Association.

Swarming, and Capturing and Hiving Swarms.

Swarming is the result of a natural instinct in bees for the reproduction of colonies. At a certain time of the year the hive becomes crowded, the queen laying drone eggs, and the bees at the same time constructing queen cells. With the completion of the queen cells, the larger part of the colony accompanied by the old queen leaves the hive with a view to establishing another colony.

Natural swarming may be prevented by dividing the colony, as is described under "Practical Hints," and so anticipating the event, and saving trouble to the bee-keeper, who has otherwise to watch for and endeavour to capture the swarm, with the risk of losing it altogether. The first swarm usually settles close to the hive ; but after swarms, or "casts," generally fly to a distance. The reason of this is that the first is accompanied by the old queen, who is not so active as a young and vigorous queen. When a swarm is not disposed to settle, water may be sprinkled over it with a garden spray. This is better than throwing sand on it. If a hived swarm escapes, on recapture it should be given a frame with brood, some of which should be uncapped. If such a frame is not available, close up the entrance, and keep the hive in a dark, cool place for a day. This will probably quiet them down. When a swarm is on a branch, the whole mass should be shaken into a convenient receptacle,

which should be then turned over and laid on a board. For capturing swarms, a light box of a convenient size and shape should be specially provided. Many prefer a straw "skep" for this purpose. The box or skep with the bees should be left in the shade for a while till they quiet down. The hive to be colonized can be brought to the place of capture, or the swarm conveyed to where the hive is, whichever is more convenient. The great point is to make sure that the queen has been taken. If taken, the box may be left with a side lifted, so that any bees left out may enter. Swarms can also be captured by means of the swarm catcher already referred to.

Where the bees are in a hedge or hollow, the box should be placed as near as possible to the position occupied, above the bees. With the aid of a few feathers or soft sticks dipped in a solution of carbolic acid the bees could often be dislodged and persuaded to enter the box by gradually following, or, so to speak, pushing them in.

To hive a swarm that has been captured, the following procedure should be adopted :—In front of the hive place a plank of the same width as the hive, and level with the alighting board. Turn the box containing the bees over, and gently shake it so that the bees will fall on to the platform arranged for them, and enter the hive which should be slightly raised off the bottom board so as to provide ready ingress. The tendency will be for the bees to enter the dark space within the hive ; but they may need to be helped by means of a feather so as to prevent them from travelling outside the platform ; sometimes the use of a subjugator may be found necessary. As soon as the queen is seen, she should be captured without injuring her, and one of her wings clipped with a pair of sharp scissors. After a swarm is placed in a hive, it is advisable to give it a feed to quiet it down. The entrance guard will now be useful in preventing the queen from getting out of the hive.

Further Practical Hints.

Hive.—Decide upon the hive you propose to use before you begin. The whole success of bee-keeping depends upon the interchangeability of the frames. Having two or more sizes in an apiary nullifies the advantages of the modern system.

Location.—Select a good location for the hives. A south-easterly aspect is advisable. Shade—especially during the the middle of the day—is essential. Do not place hives close to a wall ; leave a clean path of at least 3 feet behind and all around. Keep weeds down in the neighbourhood of hives. The stand for a hive should be low enough to admit of easy examination.

Handling Bees.—The two requisites for successful handling are confidence and skill, or rather deftness. The bee-keeper must practise the "large, slow gestures" which Maeterlinck enjoins. The following points need to be borne in mind :—

A hive is generally easy to manipulate when honey is coming in plentifully. In a hive with no stores, or with sealed stores, the bees are usually in a bad temper. A queenless colony is vicious. When the weather is very sultry, the bees are irritable. If a colony is raised to a pitch of stinging, it is wise to cover it up and retire. The bees can often be quieted down by sprinkling the hive with warm syrup before handling. Jarring is fatal to successful manipulation. Always approach the hive gently and from the rear, quietly raise the lid without a sound, and put it away. Next peel off the quilt, if there be one, with one hand, and if necessary subjugate the bees with smoker or subjugator. While the bees are filling themselves with honey, do what is required quickly but quietly. Make no sudden movements, and do not allow your breath to enter the hive. Never lift a frame till it is shifted laterally quite clean off the rest. Avoid crushing a bee, as the odour of the poison irritates the rest. If a bee happens to sting, do not flinch, but scrape off the sting and touch the spot with a deodorant. Before and after the honey flow, bees are generally troublesome. Between 8 and 10 in the morning is a good time to examine hives.

Feeding.—During very dry and very wet seasons it may be found necessary to feed bees. The common food given to bees is syrup, which is prepared by pouring boiling water on pure white sugar and stirring until dissolved. Use 1 lb. sugar to $\frac{3}{4}$ pint water. Dry sugar in the form of "bee-candy" can also be used. The following is a recipe for candy. In a copper pan put 10 lb. granulated sugar and a tea spoon of cream of tartar and pour over $1\frac{3}{4}$ pints water; put over a brisk fire, occasionally stirring the mixture; keep till it boils for about 3 minutes—preventing frothing over—and take off the fire. Place the pan in a vessel of water, and keep on stirring till the mass becomes cloudy. Ladle out the candy into moulds or on to plates overlaid with paper.

Dividing a Colony.—First shift the hive to another position, at least 6 feet away, and place a fresh empty hive in its place. Next remove three frames of brood and bees with the queen from the stock into the empty hive, and insert with them three frames with foundation, alternating them with the comb frames. Now replace the frames removed from the original hive with fresh ones containing foundation, or with empty frames. If a fertile queen can be given to this stock, much

time will be saved; but the queenless stock will, as a rule, raise a new one for itself. Dividing is best done on a fine day when the bees are active and during the swarming season. The hive should be thickly populated.

Uniting two Colonies.—Bring the two hives close together by moving them about 3 feet a day. Mix some thin syrup (1 lb. water to 1 lb. sugar) with 8 drops of essence of peppermint. After subjugating the two colonies, sprinkle them with the syrup (another plan is to dust them with flour). After about 3 minutes, space the frames of the colony from which the queen is to be removed (A) wide apart, by removing some of the frames, and take other frames from B and alternate them with the frames in A, placing the combs with brood close together. Frames without brood may be left out, but the bees on them must be brushed into A with a feather. Two colonies, one being queenless, can be united in the same way.

To Replace a Queen.—The absence of a queen, from one cause or other, is a serious matter, particularly in the case of a hive which has recently swarmed, as there are sometimes no larvæ young enough from which to raise a queen. When the queen through old age begins to lose her fecundity, the workers kill her either by "balling" (smothering) or stinging, and raise another. The absence of a queen is indicated by a restlessness among the bees, as though they are searching for something. In time they may quiet down and raise a new queen; otherwise they become listless, and it will be noticed that there is no brood in the combs. If a spare queen is not available, the best course would be to unite the queenless colony with one that has a queen. A colony from which a swarm has issued must be kept under careful examination to see that it is not queenless for long.

Raising Queens.—When a strong hive is deprived of the queen, the bees will begin to construct queen cells, which could be cut out and utilized for queen rearing. To induce the building of queen cells in a convenient situation, a new comb is inserted in the brood nest of a hive in which it is desired to raise queens. In three or four days this is removed and will be found partially filled with eggs. Along the lower edge make one or more oblong holes about ¾ inch deep. These are so made that, along the top edge, a row of cells is left with eggs or young larvæ in them. Destroy every alternate egg or larvæ by thrusting a match into the bottom of the cells. Enlarge the entrance to the cells that are left with eggs or larvæ, by means of a small cone pushed gently in. The cells on the opposite side of the comb must have their eggs and larvæ destroyed. Each enlarged cell containing egg or larva will be formed by the bees into a queen cell. These queen

cells are then cut out of the comb and introduced to nucleus colonies, so that the queens may be reared and be available when required.

The Nucleus Colony.—Take three combs from a strong colony, together with bees, but without the queen. Insert in a special small hive large enough to hold the frames. Close and leave for a day. If many bees have gone back to the mother colony, some more bees must be transferred (shaken in) to the nucleus. The frames in the nucleus colony should have both brood and honey, the middle one with brood and eggs, and the two outer ones with honey. Having cut out a queen cell with a sharp knife insert it into the nucleus. Some do this by placing it in a hole made in one of the nucleus combs, but the best plan is to use a spiral cage just sufficient for the queen cell. This can be made by winding fine iron wire round a cone-shaped piece of wood as a mould. Place the wire cage, with queen cell within, between two bars of the nucleus, fixing it securely in position. The opening in the thin edge of the spiral must be large enough for the queen to get out. Draw frames close together and cover up hive. Soon after the queen emerges into the hive she will make a number of trial flights till she is ultimately fertilized, when she will settle down, and begin to lay eggs. The queen will now be ready for introducing to any colony requiring one. After removal of the queen from a nucleus another queen cell could be inserted, provided the strength of the colony is kept up. It often happens that a colony will not accept a queen at once, and in order to provide against her destruction, she is placed in a cage, in which she is left within the hive for a couple of days till the bees get accustomed to her.

Fixing Foundation.—Foundation is provided either as a complete sheet to fill the whole frame, or as a strip fixed along the top bar to serve as a starter. Full sheets are to be preferred. It is usual to have a thin groove on the under surface of the top bar into which to insert the upper edge of the foundation. A rough and ready method of fixing the foundation is by running melted wax along the sides of the frame, holding sheet in position while doing so. A better way is to employ fine tinned wire and form a skeleton frame work with it, running the wire in and out at intervals by passing it through the upper and lower bars or the two side bars of the frame. Next lay the sheet of foundation on a board of a size to fit into the frame, place the frame in position over the board, and imbed the wire into the foundation. This is done by means of a wire imbedder, consisting of a circular disc (a cent piece will answer the purpose) with an attachment that enables the operator to wheel it along the wires. By previously heating

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the disc, it will melt the wax along its route, and so help to weld the wire and foundation together.

Transferring.—This is the removal of a stock with combs and brood from a natural or artificial hive to a new hive. This is only worth doing if the combs are nice and straight; not if they are old, discoloured, and badly constructed. The operation is a difficult one, and is best done by first driving the bees (if possible into a temporary receptacle) and then attaching the best combs with brood to frames by means of tape. When this is done, the bees can be put into the new hive. Care should be taken that the queen is among them.

Bee Pasture and the Honey Flow.

By bee pasture is meant the vegetation from which bees derive their honey and pollen.

In countries where bee-keeping is practised on business lines, special attention is paid to the question of bee pasture, and either special crops, such as clover, are provided for the bees, or the hives are moved to favourable situations. In the East bees appear to depend chiefly on perennial trees for their food, but where other plants which serve their purpose are available, they do not fail to utilize them.

The following are some of the plants frequented by bees in the East :—The Coconut Palm, Mi (*Bassia longifolia*), Albizzia, Acacia, Cassia, Citrus fruit trees, Coffee, Durian, Wild Olive (*Elaeocarpus*), Mango, Eteriya (*Murraya exotica*), Padouk (*Pterocarpus indicus*), Kon (*Schleichera trijuga*), Divi-Divi (*Caesalpinia coriaria*), Bulu (*Terminalia belerica*), Banana, Dhall (*Cajanus indicus*), Guava, Jambu (*Eugenia*). Logwood, which has been introduced into the Island, is likely to prove a valuable addition to our bee pasture. Many exotic flowering plants are sources of nectar to bees, suggesting the suitability of gardens for the keeping of hives, with a double advantage to the owner. The following are the bee plants commonly found in gardens :—Sweet Alyssum, Calliopsis, Candy Tuft, Honeysuckle, Canterbury Bells, Mignonette, Nasturtium, Sun Flower, Sweet Basil, Strobilanthes, Antigonon, and Cleome.

Mr. L. W. Barber speaks in high praise of fennel, and Mr. Shanks of *Hedyotis fruticosa* (Sin. Weraniya).

The following note by Mr. Goonetilleke is of interest in this connection :—

"Almost all our perennial trees provide bee food, either nectar, pollen, or both. I have seen bees on such trees as Badulla, Daminiya, Keena, Mora, and Pus-wel, as well as on tiny plants like Mustard and Coriander. The coconut provides more pollen than nectar. (The writer has watched bees sipping up the drops secreted by the female flowers of the coconut.) The plantain

(banana) yields a plentiful supply of nectar. Tea, cotton, and tobacco are other sources. Bees also work on the tender leaves of certain trees (*i.e.*, Uguressa) from which they gather honey-dew."

Clover and Lucerne are excellent honey plants, and should be grown wherever they are found to thrive. The white scented annual "Hubam" clover (*Melilotus alba*) is very highly spoken of as a source of honey.' It is being given a trial by members of the Ceylon Bee-keepers' Association, and has been found very useful by some.

The "honey-flow" is the period of abundance of honey, due to the free flowering of honey plants. There are two more or less definite honey-flows during the year. The main honey flow occurs in the early part of the year, between January and May, April being frequently the best month; but the height of the flow is regulated by weather conditions. The bees know the approach of this season and prepare for it. The queen becomes very busy over laying her eggs, with the result that the hive is full of workers ready to gather in the harvest of honey. But there is also an increase in the number of drones bred out, and a tendency towards swarming, which must be anticipated by adopting ways and means for controlling it. During the rainy months it will be found that little honey is gathered. In the second half of the year there is generally a small honey flow between August and October, when swarming is not so common as during the first flow.

The object of the bee-keeper should be to take advantage of these honey flows by keeping his colonies strong, but at the same time adopting measures to control swarming.

Pests and Diseases.

The pests that have to be guarded against are the wax moth, garden lizard, gecko, toad, cockroach, bat, ants, the king crow, wasp, spider, praying mantis and death's head moth, and mites.

Keeping a colony strong is the best method of prevention against these pests, but the bee-keeper must adopt every means to protect his bees from their enemies. Practical measures will suggest themselves to him.

Owing to the trouble caused in this way, it is necessary to keep hives not far from dwelling houses, and also to set them up on stands, which should not be more than 3 feet high, so as to allow of their being easily examined. The plan of placing hives 4 and 5 feet high is to be deprecated. The cheapest stand is a post (preferably of some hard wood, Milla or Ketakela) with a plank fixed on the top. This post should be furnished with a zinc attachment round it to keep away ants.

Ceylon bees are fortunately singularly free from the serious diseases which occur in the West; but dysentery and paralysis

are known to occur, due chiefly to damp and insanitary conditions prevailing in the hive. A safe and tried remedy is the use of a medicated syrup, prepared as follows:— Dissolve 1 oz. of beta naphthol in 8 oz. of spirits of wine; thoroughly shake up before using. Add two teaspoonfuls of this to 6 lb. of cool syrup.

Advantages of Bee-keeping.

Many people look upon bee-keeping as a useless hobby, but it has advantages that only those who have made a study of it realize.

It is an intellectual pursuit in itself, and Maeterlinck refers to "the school of bees," to which one may go "to be taught the preoccupations of all-powerful nature, the harmonious concord of the three kingdoms, the indefatigable organization of life, the lessons of ardent and disinterested work."

It is an aid to health, providing as it does fresh air, sunlight, recuperative occupation of mind, a moderate amount of exercise, all conducive to our well-being.

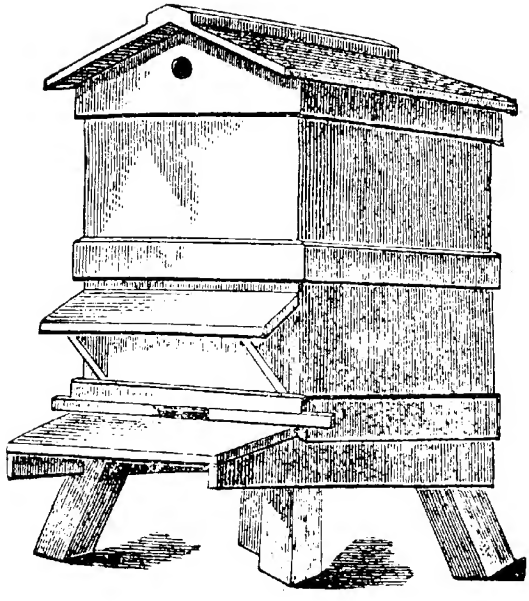
It can be made a source of income, if prosecuted on business lines; and, apart from the initial expenditure on the hives and accessories, bees cost nothing to keep, and yield a return in honey and wax, that can either be sold or utilized in the household of the bee-keeper. Lastly, it is an aid to Agriculture and Horticulture. Why do flowers produce nectar, but as an attraction to bees and other insects, which, while gathering it, carry the pollen from one flower to another, and so effect fertilization? Some crops (such as clover) would not produce seed but for the intervention of bees, which thus help to increase its value as hay.

Without the help of bees fruit-producing plants will be less productive, and wherever bees are kept, the produce of such trees is increased. This is a point which calls for the serious consideration of the planter, to whom the production of fruits and seeds is a matter of concern.

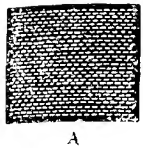
It would not be out of place here to say a word on the value of honey as human food. It has been described as "the quintessence of food," and not incorrectly. In a pamphlet issued by the British Bee-keepers' Association occurs the following:— "Honey in its natural state is already in condition for absorption into the system, hence its superiority over all other kinds of food." Recent investigations have revealed that honey is rich in vitamines, and specially valuable as a diet for young children and invalids.

C. DRIEBERG.

Plate I.



Modern English Hive complete with Super and Stand.



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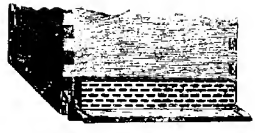

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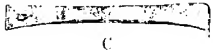

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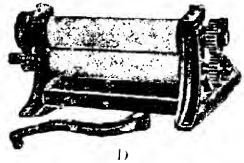

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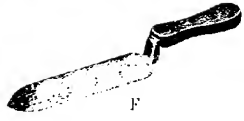

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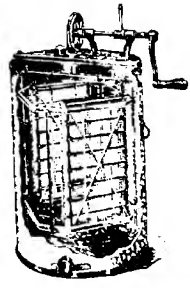
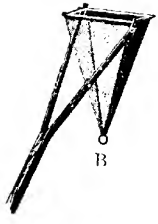


H

A.- Queen excluder.
B.—Entrance guard.
C.—Hive tool.
D.—Foundation machine.

E.—Bee brush.
F.—Uncapping knife.
G.—Porter Bee escape.
H.—Honey extractor.

A



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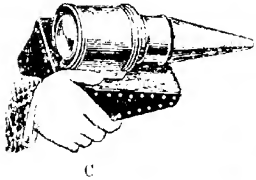

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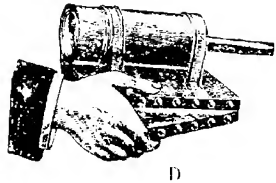

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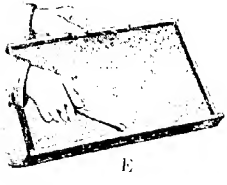

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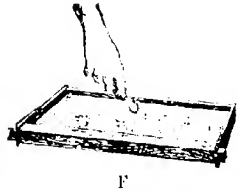
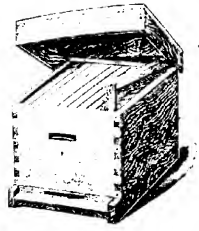


F

A.—Bee veil.
B.—Swarm catcher.
C.—Smoker.

D.—Subjugator.
E.—Fixing comb-foundation.
F.—Wiring foundation.

Plate IV.



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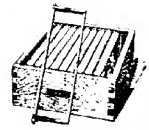

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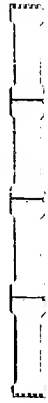

E

F

A and B.—Brood-box and frames.
C.—Super.
D.—Section.

E.—Section before folding.
F.—Sections in frame.